MINISTERIO DE CIENCIA E INNOVACIÓN

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Plan de Recuperación, Transformación y Resiliencia

AGENCIA ESTATAL DE INVESTIGACIÓN

CURRICULUM VITAE (CVA)

CV date	24/01/2024

Part A. PERSONAL INFORMATION

First name	Carlos		
Family name	Sánchez Muñoz		
Gender	Male	Date of Birth	14/09/1988
ID number	05707515L		
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Open Researcher and Contributor ID (ORCID)		0000-0001-8775-0135	

A.1. Current position

Position	Científico Titular		
Initial date	20/12/2023		
Institution	Instituto de Física Fundamental, CSIC		
Department/Centre	Departamento de Física Cuántica		
Country	Spain	Phone number	686655120
Keywords	Quantum Optics; Quantum technologies; Light-matter interaction; Photon correlations; Quantum metrology; Quantum spectroscopy		

A.2. Previous positions

Period	Position/Institution/Country/Cause of the interruption
2020-2023	Researcher (La Caixa Junior Leader)/ Universidad Autónoma de Madrid / Spain
2018-2020	Postdoctoral Researcher -Marie Curie Fellow / University of Oxford /United Kingdom
2017-2018	Postdoctoral Researcher - JSPS Fellow/ RIKEN / Japan

A.3. Education

PhD, Graduate Degree	University/Country	Year
PhD in Condensed Matter Physics and Nanotechnology	Universidad Autónoma de Madrid	2016
Master in Condensed Matter Physics and Nanotechnology	Universidad Autónoma de Madrid	2012
BsC in Physics (Licenciado)	Universidad Autónoma de Madrid	2011

Part B. CV SUMMARY (max. 5000 characters, including spaces)

I am a theoretical physicist specialized quantum technologies, with a focus on exploring unique regimes of light-matter interactions in open quantum systems and their applications in quantum metrology.

Trajectory. With 11 years of research experience (4 PhD +7 Postdoct). I earned my PhD in Dec 2016 at Universidad Autónoma de Madrid (UAM) (Cum Laude, Best Theoretical Thesis Award by GEFES and Premio Extraordinario de Doctorado by UAM), with advisors C. Tejedor and F. P. Laussy. During my PhD, I obtained two Mobility Grants that funded stays at Max Planck Institute for Quantum Optics (Garching, Germany) with Ignacio Cirac, and at University of Sussex (Brighton, UK) with Diego Porras. In 2017, I joined the group of Franco Nori as a postdoc at **RIKEN (Japan),** funded by a **JSPS Postdoctoral Fellowship**. In the same year, I was also awarded a **Marie Slodowska-Curie Individual Fellowship** to undertake research in Europe, moving in mid 2018 to the group of Dieter Jaksch at **University of Oxford**

(UK). Early 2020, I was awarded **a La Caixa Junior Leader Fellowship**, with which I started and led a junior independent research group at **IFIMAC (UAM, Madrid)**. In December 2023, I was appointed **Científico Titular** at **Instituto de Física Fundamental, CSIC.**

Scientific output (References with format [X] refer to the publications in the list in Sec. C.1.)
Throughout my scientific career, I have focused on investigating the interaction between light and matter at the quantum level to unveil novel dynamical regimes with inherent quantum properties
One key motivation is **to create exploitable quantum states of light for applications in quantum technologies**. I have proposed several mechanisms to generate light with non-classical correlations in cavity-QED system, including a new type of light consisting of a continuous stream of bundles with a fixed number of photons [10], a novel type of laser featuring the nonclassical properties of squeezed states [3], and quantum sources of THz radiation [1].

In the field of **metrology**, I have conducted fundamental studies of photon correlations encoded in frequency, leveraging them as a witness of quantum coherence in molecular systems [5]; descriging spectroscopy methods with quantum light [2]; or, recently, using deep learning for the reconstruction of quantum states [4]. I have also contributed towards **advancing our general knowledge of the dynamics of non-equilibrium light matter systems, exploring exotic regimes of light-matter interactions**---such as ultrastrong light-matter coupling [2,8] or the emergence BKT phase transitions [9] ---and proposing new ones, like the implementation of the novel paradigm of "giant" atoms [6].

These results have garnered significant recognition within the quantum optical community,---see e.g. [Nat. Phot. 8, 500 (2014)]. They hold promise as crucial ingredients in future quantum technologies, e.g. phase estimation in linear and nonlinear interferometers or multi-photon microscopy. I have authored a **total of 40 publications** (11 as 1st author, 8 as last author), including 1 Nat.Phot. (1st author), 1 Nat. Comm. (1st author), 1 Nat. Materials, 1 Sci. Advances, 1 Optica (1st author), 11 PRL (3 as a 1st author, 1 as last author).
h-index: 22. Citations: 1572 (Source: Google Scholar, as of Jan 24, 2024).
I have communicated these results through 35 talks (8 invited, 11 contributed, 16 invited seminars).

Independence, Leadership and International Collaborations. After my PhD, I have always succeeded in securing funding that allowed me to undertake **independent research**. Currently, I lead my own junior research group, where I supervise a PhD student working in generation and application of quantum photonic states for metrology.

I have a solid and rich network of international collaborations with key actors in the field of quantum physics, like F. Nori (Japan), I. Cirac (Germany), D. Jaksch (UK, Germany), D. Porras (Spain), D. Sanvitto (Italy), S. de Liberato (UK) and numerous young researchers (e.g. A. González Tudela, A. Frisk Kockum, F. Schlawin). Furthermore, I have motivated new interactions between several of these important actors, e.g. leading a new collaboration between Oxford and the QUINFOG group at CSIC, establishing myself as an important node in the European network of quantum researchers.

Scientific Responsibilities and Competences. I have attracted and managed funding from three highly competitive schemes (JSPS, Marie Curie IF, and La Caixa Junior Leader), managing a total research budget of more than 0.41M€. I have **ANECA Contratado Doctor qualification**, with more than **190h of teaching** at University of Oxford and UAM. I am **sole supervisor of a PhD student** and assistant supervisor of another. I have supervised 2 MsC thesis and 4 Bachelor Theses (TFG). I have produced **40 verified referee reports** to high-quality journals such as Nat Comm., PRL, PRX, and NJP, and acted as **external supervisor for the EU Quantera** programme and the Agencia Estatal de Investigación.

Part C. RELEVANT MERITS

C.1. Publications (10 most relevant)

Citations extracted from Google Scholar. AC: Corresponding author; (nº x / nº y): solicitant position/number of authors.

[1] C. Groiseau, A. I. F. Domínguez, D. Martín-Cano, C. Sánchez Muñoz, *Single-photon source over the THz Regime,* PRX Quantum (2024) (in press), AC (1/4). 2 citations.

[2] V. Macrì, A. Mercurio, F. Nori, S. Savasta, C. Sánchez Muñoz, *Spontaneous scattering of Raman photons from cavity-QED systems in the ultrastrong coupling regime,* Physical Review Letters 129, 273602 (2022). AC (1/5). 7 citations.

[3] C. Sánchez Muñoz; D. Jaksch. *Squeezed lasing*. Physical Review Letters 127, 183603 (2021), AC (1/2). 10 citations.

[4] S. Ahmed; C. Sánchez Muñoz; F. Nori; A. F. Kockum, *Quantum state tomography with conditional generative adversarial networks*, Physical Review Letters. 3, 033278 (2021). AC (2/4). 113 citations.

[5] C. Sánchez Muñoz; F. Schlawin. *Photon correlation spectroscopy as a witness for quantum coherence*. Physical Review Letters. 124-20,203601 (2020). AC (1/2). 29 citations.

[6] A. González Tudela; C. Sánchez Muñoz; I. Cirac. *Engineering and Harnessing Giant Atoms in High-Dimensional Baths: A Proposal for Implementation with Cold Atoms*. Physical Review Letters. 122, 203603 (2019). AC (2/3) 58 citations.

[7] C. Sánchez Muñoz; A. Lara; J. Puebla; F. Nori. *Hybrid Systems for the Generation of Nonclassical Mechanical States via Quadratic Interactions*. Physical Review Letters. 121, 123604 (2018). AC (1/4). 63 citations.

[8] C. Sánchez Muñoz; F. Nori; S. de Liberato. *Resolution of superluminal signalling in non-perturbative cavity quantum electrodynamics*. Nature Communications. 9-1924 (2018). AC (1/3) 67 citations.

[9] D. Caputo *et al. Topological order and thermal equilibrium in polariton condensates*. Nature Materials. 17,145 (2018). AC (4/12). 124 citations.

[10] C. Sánchez Muñoz *et al*. *Emitters of N-photon bundles*. Nature Photonics 8, 550 (2014). AC (1/9). 136 citations.

C.2. Congresses (10 most relevant)

1. CMD 30 - FisMat 2023, Milan, Italy, September 2023. **Invited Talk.**
2. Conferencia Española de Nanofotónica CEN 2023, Zaragoza, Spain, June 2023. **Invited Talk**
3. Sensing with Quantum Light (SQL20), Berlin, Germany. September 2020. **Contributed Talk**.
4. 10th International Conference on Spontaneous Coherence in Excitonic Systems (ICSCE10). Melbourne, Australia. January 2020**. Invited Talk**.
5. IoP Lectures. University of Wolverhampton, UK. October 2019 **Invited Talk**.
6. Terametanano 4: Intern. Conference on THz Emission, Metamaterials and Nanophotonics. Lecce, Italy. May 2019. **Invited Talk**.
7. XGEFES 2018 Meeting (División de Física de la Materia Condensada de la Real Sociedad Española de Física). Valencia, Spain. January 2018. **Invited Talk**.
8. 33rd International Conference on the Physics of Semiconductors (ICPS 2016). Beijing, China, August 2016. **Contributed Talk**.
9. Physics of Light-Matter Coupling in Nanostructures 2016 (PLMCN17). Nara, Japan. March 2016. **Contributed Talk**.
10. 32nd International Conference On the Physics of Semiconductors (ICPS2014). Austin, US. August 2014. **Contributed Talk**.

C.3. Research projects

1. Ingeniería Cuántica de Luz y Materia en la Nanoescala (PID2021-126964OB-100). Funding agency: Ministerio de Ciencia e Innovación, convocatoria 2021 de Proyectos de Generación de Conocimiento 2021. Duration: 09/2022-09/2025. Funding: ~150kC. PIs: Antonio Fernández. Role of the applicant: Member of the work team, collaboration in project design.

2. *Nanofotónica para Computación Cuántica (NanoQuCo)*. Funding agency: Comunidad de Madrid, Y2020/TCS-6545.Duration: 07/2022-07-2025. Funding: 657.800€. PIs: Francisco José García Vidal and Juan José García Ripoll.
   Role of the applicant: Member of the work team, collaboration in the project design.

3. *La Caixa Junior Leader*. Funding agency: Obra Social Fundación la Caixa. PI: Carlos Sánchez Muñoz. Duration: 01/08/2020-31/07/2023. Funding: 305.100 €.
   Role of the applicant: PI

4. *Frontiers in Quantum Simulation (PGC2018-094792-B-100),* Ministerio Ciencia, Innovación y Universidades. PI: Diego Porras, IFF, CSIC, Madrid. Role of the applicant: Part of work team.

5. *Marie Curie Individual Fellowship (QUSON),* PI: Carlos Sánchez Muñoz. University of Oxford, UK. 04/06/2018-04/06/2020. 183.454,8 €. **Role of the applicant: PI**

6. *JSPS Short-term Fellowship Japanese Society for the Promotion of Science*. PI: Carlos Sánchez Muñoz. RIKEN, Japan. 43000€. 01/10/2017-30/04/2018. **Role of the applicant: PI**

7. *"Quantum Optics in nanostructured semiconductors" (QOINS),* MINECO. PI: Luis Viña. Part of the work team. Universidad Autónoma de Madrid (2015/2017).

8. "*Nanoestructuras para óptica cuántica" (NANOQUO),* MINECO. PI: Carlos Tejedor. Participation: Part of the work team. Universidad Autónoma de Madrid. 466.942€ (2012/2014)

C.4. Outreach activities

1. **2023 Semana de la Ciencia:** Outreach activity oriented to the dissemination of the fundamental behaviour of light and its applications. Activity title: *Ciencia y Palomitas-Introducción a la Luz (Science and Popcorn: Introduction to light)*.
2. **Quantum Fracture Video**: "*Ya, en serio… ¿qué es la luz?" (EN: Now, seriously…What is Light?)*. Role of advisor and collaboration in writing of an outreach video about light and quantum optics in the most influential science Youtube channel in Spanish language: Quantum Fracture. As of January 2024, the video has more than 2.5M views.
3. **Artworks for outreach.** Winner of the competition Quantum Visions, art context by UK National Quantum Technologies Programme (UKNQTP) to promote quantum sciences.
4. **2019 European Researcher's Night, London , UK.**
   EU-Pub at the Natural History Museum: Activity akin to a science cafe, where European researchers discuss about science with the general public and answered questions in an informal setting.
5. **2018 JSPS Science Dialogue, Yamanashi-shi, Japan.**
   Outreach talk on quantum physics oriented to Japanese High-School students.
   Talk title: The Applications of Quantum Physics.